Rethinking Unemployment Protection in Developing Countries: Evidence and some Insights

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VERY PRELIMINARY

Abstract

This paper examines how the presence of a large informal sector alters the design and effects of unemployment insurance (UI) in developing countries. It reviews the existing literature and distills empirical evidence from several countries, and then interprets these observations through a job-search model with novel features. In the model, informality arises endogenously as a search outcome: unemployed workers can direct effort toward formal or informal jobs. The framework also incorporates fiscal externalities—particularly salient in developing economies—and accounts for repeated UI spells, allowing future benefit eligibility to shape current incentives to formalize. These elements make it possible to revisit traditional UI effects and uncover new ones, such as the directed moral hazard and the eligibility effects. Overall, the paper underscores the importance of explicitly considering informal employment when evaluating the welfare effects of UI and designing unemployment protection systems in contexts where informality is widespread.

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1 Introduction

Unemployment Insurance (UI) is a largely studied and very important policy in developed countries, that provides individual workers means to face income drop upon job loss and the economy to deal with raises in unemployment during recessions. Its designs, effects, and welfare implications has been widely studied (Tatsiramos and van Ours, 2014; Schmieder and von Wachter, 2016), and reforms in labor markets due to rapid technological change calls for new research on the issue.

This policy is far less important in developing countries: there are no UI in many countries, and the evaluation of effects is scarce or absent, even in the case of those countries that have some transfers.

The effects of UI are possibly very different in developing countries. In these countries, households are affected by more severe liquidity constraints; they can earn informal wages, while the government usually only observes formal jobs; self-employment is prevalent; inequality is higher (including residual inequality in wages); labor market frictions are large.

These characteristics make the possible behavioral impact of UI potentially very different. For one, workers have incentives to accept informal jobs (or to self-employ) while receiving UI. But the existence of beneficiaries informally employed is not evidence per se of a distortion, as it could well be the result of the lack of formal jobs available, or the need to self-smooth consumption under liquidity constraints. Second, fiscal impact of UI could be also different, with fiscal externalities playing a larger role. Other social transfers (such as Conditional Cash Transfers to households) are possibly available for workers after UI exhaustion, and, more important, an informal job is related to an economic activity that is not observable by the government and that does not pay taxes (not only taxes related to UI, but no tax at all).

In general, welfare implications of UI could be very different: transfers are possibly more important for smoothing consumption because of liquidity constraints, but informal income could balance this lack of financing and could add to moral hazard effects. In all, and due to this context, the design of UI in developing countries seems a more complex challenge.

This paper reviews some key findings on the effects of UI in some selected developing countries. Using this thin but important literature, it characterizes UI systems and beneficiaries, it shows the important behavioral responses to UI, and highlights some key facts.

This literature has typically connected to the sufficient statistics approach (Baily, 1978; Chetty, 2008; Schmieder et al., 2012) to evaluate the welfare effects of UI, where liquidity and moral hazard effects are crucial for the understanding of behavioral responses to transfers. The liquidity effect arises when individuals cannot smooth consumption, and UI affects search behavior by reducing their urgency to find income. The moral hazard effect relates to the

substitution generated by the fact that workers lose their UI benefits when the government observes their new job, an effective reduction of the reemployment income. The relative importance of the liquidity effects over the moral hazard effect determines the optimal level of UI (Chetty, 2008).

This paper provides additional insights, by building a search model that allows for revisiting these well known effects. In the model, the workers are able to partially direct their search towards formal or informal jobs; the government does not observe informal jobs, but is aware that inducing workers to search for informal jobs generates a fiscal externality by reducing tax base. Using this model, this paper shows that liquidity effect could be quantitatively and even qualitatively very different to the usual interpretation. It also shows that, in addition to the traditional moral hazard effect, there is a directed search moral hazard when incentives makes workers to search more for informal jobs and away from formal jobs. Finally, in these cases, when formal and informal jobs are, in fact, close substitutes, eligibility effect becomes more important: formal jobs are valued not only by their higher wage but also because UI provides workers with some insurance for the event of a formal job loss.

This framework is able, then, to link to many facts observed in developing countries: formal job-finding rate is lower during UI eligibility period, at the same time many workers have access to informal income; after UI exhaustion, formality quickly gains at the expense of informality; workers in lower consumption households tend to be in informal jobs.

The relative importance of eligibility and directed search moral hazard is, then, explored. First, the paper shows that some empirical results of the literature are in line with these effects. Second, through a quantitative model, it shows that these effects could be as important as the traditional ones. Finally, the paper concludes by acknowledging the limitations of the approach, but argues on the importance of explicitly considering informality in welfare analysis and on the value of generating additional empirical facts on the effects of transfers in developing countries.

I will review the main characteristics of UI and its effects in developing countries before presenting the conceptual framework.

2 Insurance under high informality: some facts

Some papers have analyzed the characteristics of UI, their beneficiaries, and their jobs, for developing countries. I concentrate on the countries where UI has been more frequently analyzed in the recent literature. These countries are Argentina (Gonzalez-Rozada and Ruffo, 2016b; González-Rozada and Ruffo, 2023), Brazil (Gerard and Gonzaga, 2021), and Mauritius (Liepmann and Pignatti, 2024). We also include some comparisons with other countries

including Senegal (Ndiaye et al., 2025), and Indonesia (Wongkaren et al., 2024).[1]

UI system differs by country, but has some commonalities. First, it is provided with limited duration. This potential duration can be homogeneous for all eligible workers (Mauritius, Indonesia) or can differ according to the number of pre-unemployment contributions (Brazil) or even age (Argentina). Potential duration ranges from 3 to 5 months in Brazil, 12 months in Mauritius and from 2 to 18 months of potential duration in Argentina. These extensions are typically shorter than the ones in developed countries, but still comparable.

Some jobs may be ineligible for UI due to the industry or other characteristic. For example, construction sector has a different UI system in Argentina, with a slightly different potential duration compared to the general system.

The level of UI also varies, but the rules are also comparable to the systems in many developed economies: transfers at the beginning of the eligibility period are determined by a common replacement rate with a maximum and a minimum level. For example, in Argentina until 2023 the net replacement rate was 50%, but with binding minimum and maximum levels.

For some countries the individual replacement rate is very heterogeneous. For example, in Brazil UI transfers can replace 100% of the pre-unemployment wage for some workers, but is 65% for the average beneficiary. In Mauritius only 13% of beneficiaries are affected by the maximum UI level, suggesting that initial heterogeneity in replacement rate is less important in that country. In Argentina, in 2006, the median beneficiary was at a 50% replacement rate, but given that the maximum threshold was not updated for years, the average replacement rate was reduced progressively until 2016 and 2023 reforms (Gonzalez-Rozada et al., 2011).

The level of UI is decreasing in duration for some countries. In Argentina goes down by 15% of the initial level after the first four months, and another 15% at the ninth month on. In Mauritius, replacement rate begins at 90%, but drops to 60% for months 4 to 6, and to 30% from 7 to 12. In Indonesia, the initial replacement rate is 45% but goes down to 25% from the fourth month.

In all, both in level and duration, UI systems in these developing countries are relevant transfers that could have important effects on behavior. The literature of UI for developing countries have several common empirical observations that we want to emphasize. In what follows, I summarize some important results of the empirical literature.

The first fact to note is that most beneficiaries exhaust UI. For example, in Mauritius about 70% of beneficiaries received the full 12 months of potential duration, and the average

[1]This limited number of countries in the review is in part explained by the lack of UI evaluations in many important countries. In addition, some countries have particular UI systems that make them of little relevance in the comparison with the literature reviewed here. The case of individual savings accounts in Chile is an example (Sehnbruch et al., 2020, 2022).

UI duration is 10.3 months. In Brazil, workers entitled to 4 months of UI collected close to 4 months of UI transfers, while those with similar characteristics but 5 months of potential duration collected 4.9 months of UI on average. In Argentina the proportion of workers that exhausted their UI transfers is higher than 80% for short potential durations and between 40 to 55% for UI longer than eight months (Gonzalez-Rozada et al., 2011). In Indonesia the average months of UI benefits is 5, with a total potential duration of six months.

The second fact is that many UI beneficiaries are employed at informal jobs. In Mauritius, 50% of workers were working informally after six months of collecting UI and upon exhaustion. Only a 30% of workers have found a formal job at UI exhaustion, ie. after one year from job loss. Data from surveys in Brazil show that about 70% of workers close to exhaustion of UI are employed, suggesting that many of UI eligible workers have informal jobs at the same time they collect benefits. From these informally employed, two thirds are employees and the remaining ones independent workers (mostly self-employed). Additionally, in Brazil, household surveys are used to estimate hazard rates to employment (to both formal or informal employment). From this data, Gerard and Gonzaga (2021) find that the probability of finding any job is about 22% during the first month after layoff, and then goes down to 18% by the third month. In comparison, using administrative data, the hazards to formal jobs is about 4% during the second and third months after layoff. Survey data from Argentina shows that about half of the beneficiaries have found an informal job, and their labor income almost doubles the UI transfer(Herrera et al., 2025).

Third, there is strong evidence that, at exhaustion, formal job-finding increases and informality goes down. The evidence presented in Mauritius shows that few months after exhaustion there is a mild increase in formal job-finding. Only part of this increase is at the expense of lower informality. But it is in Brazil where there is a sharp spike in formal reemployment at UI exhaustion. At the same time, survey data does not imply a sharp spike in overall reemployment rate at UI exhaustion what implies a significant substitution from informal to formal jobs at exhaustion. This could mean that workers transit from informal to formal jobs, for example through a job-to-job search, or also that workers are formalized within the same job. Finally, evidence for Indonesia also suggest that formal job-finding increases after UI exhaustion.

Fourth, for some workers informality could be a persistent state. While some workers transit quickly from informality to formality after UI exhaustion, other workers seem to extend their informal jobs much longer. In Brazil, for example, it has been shown that workers who received an extended UI spent less time in formal jobs over the next two years.

The fifth observation is that the income drop upon displacement is substantial, in some countries even for workers that have informal income and are eligible for UI. In Brazil,

income (household disposable income per capita) does not change significantly when the worker becomes formally reemployed. But for workers with an informal job typically lose 24-35% of their income. At UI exhaustion, income drops by 51-54% if the worker does not have a job, and about 30 to 37% of these households do not have any source of income at all. In Argentina, household income goes down strongly after formal job loss. For example, UI beneficiaries lose about 70% of their family income. Nevertheless, reemployed workers at informal jobs experience a reduction in household income of about 20%.

Sixth, consumption losses are also strong, in some cases reflecting very little means to smooth consumption. Consumption losses are, again, computed as differences between job losers and similar formal workers that were not laid-off. In Argentina, consumption losses are relatively milder compared to income losses. For example, while household income goes down by 38%, household consumption drops by 34%. In Senegal, national surveys show that there is a very large 65% gap between income from formal and informal workers. This difference is reduced to a 38% gap of household consumption per capita. Unemployed workers have typically no income but still their consumption is not significantly lower compared to informal workers, suggesting that they could be depleting savings or relying on family support. The reduction in non-durable consumption (in fact, non-durables per capita family expenditure) is as strong as 31.4% in Mauritius. Additionally, expenditures are sensitive to UI reductions: household expenditure is reduced at months 4 and 7, when UI level declines. Importantly, consumption drop is larger among those workers that have informal jobs, while those continuously unemployed show consumption paths similar to those who become formally re-employed. These observations suggest that informal jobs are a way to avoid larger consumption drops, and that informal jobs still offer poor income replacement, and do not fully prevent further consumption fall.

Seventh, UI has important effects on the behavior of workers, in particular on formal job-finding. For example, it is frequently observed that formal job-finding rate spikes at UI exhaustion or that extending UI potential duration (for example from four to five months) induces lower job-finding since the beginning of the unemployment spell. For example, the extension of UI potential duration has an almost one-to-one effect in the UI duration or even in unemployment duration during eligibility (the paid UI duration). The case of Brazil shows that extending UI benefits potential duration by two months generates a reduction in formal reemployment rate: about 15% more workers were still without a formal job in the seventh month of UI compared to the control case where UI is exhausted at five months. Also in Brazil, other effects of potential duration were identified using a Regression Discontinuity (RD) approach: workers with 23 months of tenure in the sample were eligible for 4 months of UI potential duration, while workers with 24 months had access to 5 months of UI. Comparing

both cases, it is found that the extension of one month generated 0.9 months of UI effective duration (from 4 to 4.9 months on average). When UI potential duration was extended by two months, the total UI duration increased by 1.87 months (Gerard and Gonzaga, 2021). Besides duration, the impact of the level of transfers is less studied. In the case of Brazil there is no impact evaluation identifying the level of UI benefits, but Gerard and Gonzaga (2021) find that samples of workers with different UI replacement rates have similar effects of UI potential duration, suggesting that UI level is not driving the results. In Argentina, González-Rozada and Ruffo (2023) exploit the kink in the relationship between benefits and pre-unemployment reference wages to identify the effect of increasing the level of transfers. That paper finds that total UI paid increases by 1.04 to 1.17% for each one percent increase in initial transfer. That is, most of the effect is mechanical, and transfers only increase 0.17% due to behavioral responses. Herrera et al. (2025) report similar behavioral effects (an elasticity of between 0.16 to 0.22) on total non-formal employment duration, including periods beyond UI eligibility. The results in these papers show that, while effects are significant and important, most of the effects are mechanical, while behavioral effects are mild (Gerard and Gonzaga, 2021).

3 A conceptual framework for interpretation

To interpret some of these facts it is convenient to set a more formal conceptual framework. A search model can allow for exploring the role of UI on search behavior, introducing the most important effects discussed above. Furthermore, a properly calibrated model could be helpful for identifying and assessing the possible welfare gains and, eventually, to characterize optimal policy in this setting.

There are three main innovations compared to the models typical in the literature (Chetty, 2008). The first is that informality is modeled as a job, instead of an income. In this sense, this income is a result of a search process, and workers are able to partially direct their search. This is implemented through nonlinear search cost and search effectiveness functions. It could be optimal for workers to substitute search effort from formal to informal jobs if UI becomes distortionary. The importance of the degree of this substitution in the design of UI would be explored in the welfare gains analysis.

The second issue of the framework is the introduction of fiscal externalities. In fact, fiscal externalities have been analyzed in this context (Lawson, 2017). But under high informality this issue becomes crucial. If a worker is informally reemployed, the government loses not only the payroll taxes that finance UI, but all taxes related to the economic activity of that job.[2] Additionally, some policies, such as Conditional Cash Transfers or Non-Contributory Pensions could lead to benefits that are financed by contributions of the formally employed workers but that benefit all individuals at retirement age (see for example González-Rozada and Ruffo (2016a) for the effects of a tax amnesty on pensions in Argentina).

The third difference with other setups is that repeated spells of UI are explicitly modeled. This leads to the analysis of the effects of benefits in future UI spells on current workers' decisions. This exploration would show the importance of the eligibility effects.

Let us consider a risk-averse worker, that derives utility from the consumption of the per-period income (hand-to-mouth worker). Workers begin their working life unemployed at period $t = 0$, and live for T periods. An unemployed worker exerts effort, s_I, s_F, to search for a formal or informal job, respectively. This search has an utility cost, given by $\Psi(s_I, s_F)$, with $\frac{\partial \Psi(s_I,s_F)}{\partial s_J} > 0$ and $\frac{\partial^2 \Psi(s_I,s_F)}{\partial s_J^2} < 0$. The rate of success of search effort is determined by a concave function, $\pi_J(s_J)$, where $\pi' > 0$, $\pi'' \leq 0$. Search effort can be directed to both formal and informal jobs. If the worker does not find a formal job, the worker would receive a government transfer in the form of UI. After finding a formal job, the worker collects wages net of income taxes, $w_F - \tau$, where τ is the tax, and cease to collect UI; after finding an

[2] An informal job can only be paid through income of firms that operates informally, at least partially. But sometimes informal payment ("payments under the table") are present in otherwise formal jobs, suggesting some tax evasion also in those jobs. This means that informal jobs are partially related to overall tax evasion.

informal job, the worker collects both the informal wage, w_I and the government transfer. Workers lose their jobs at a rate δ_J, $J = \{I, F\}$ and have to search for a new job.

The UI system is defined as transfer,b_d, that could depend on duration, $d = 1, 2, ...$ This includes the case in which the transfer is constant for a given potential duration B. The initial benefit is considered to be proportional to the formal wage, so that the ratio b_1/w_F is the replacement rate. Additionally, in all cases, the worker receives a constant non-labor income, y. This amount would be useful to derive liquidity effects. Also, when considering the problem of the government, it will be the source of fiscal externality because the government has to collect taxes to pay for it.

We assume that workers with informal jobs have incentives to search for a formal job, so that we would consider the same utility cost of search, $\Psi(0, s_F)$, and a particular search effectiveness function, $\pi_E(s_F)$. But formal workers have no incentives (and cannot search) for an informal job.

Under this setup, the value function for a worker who is formally employed in period t is

$$V_{Ft,d} = u\left(w_F - \tau + y\right) + \beta\left[\delta_F J_{t+1,1} + \left(1 - \delta_F\right) V_{Ft+1,d+1}\right]$$

where

$$J_{t,d} = \max_{s_F, s_I}\{-\Psi\left(s_F, s_I\right) + \pi_F\left(s_F\right) V_{F,t} + \pi_I\left(s_I\right) V_{It,d} + \left[1 - \pi_F\left(s_F\right) - \pi_I\left(s_I\right)\right] U_{t,d}\}$$

is the value of searching in period t and unemployment insurance duration d. In this function, the probability of getting a job is imposed to satisfy $0 \leq \pi_F\left(s_F\right) + \pi_I\left(s_I\right) < 1$. Additionally, the value function of being informally employed in period t is

$$V_{It,d} = u\left(w_I + b_d + y\right) + \beta\left[\delta_I J_{t+1,d+1} + \left(1 - \delta_I\right) J_{It+1,d+1}\right]$$

where the fact that informal jobs also collect UI benefits is apparent. Additionally, the informal worker can search on-the-job for a formal worker, so that

$$J_{t,d} = \max_{s_I}\{-\Psi\left(s_F, 0\right) + \pi_E\left(s_F\right) V_{F,t} + \left[1 - \pi_F\left(s_F\right)\right] V_{It,d}\}.$$

The value function of remaining unemployed at period t is

$$U_{t,d} = u\left(b_d + y\right) + \beta J_{t+1,d+1}.$$

Under this setting, workers decide optimally how much effort to exert in formal or informal job search. The following conditions characterize this decision:

$$\frac{\partial \Psi\left(s_{Ft,d}, s_{It,d}\right)}{\partial s_F} \geq \pi'_F\left(s_{Ft,d}\right)\left[V_{Ft} - U_{t,d}\right]$$

$$\frac{\partial \Psi\left(s_{Ft,d}, s_{It,d}\right)}{\partial s_I} \geq \pi'_I\left(s_{It,d}\right)\left[V_{It,d} - U_{t,d}\right]$$

Finally,

$$\frac{\partial \Psi\left(s_{Et,d}, 0\right)}{\partial s_E} \geq \pi'_I\left(s_{Et,d}\right)\left[V_{Ft,d} - V_{It,d}\right]$$

The first condition is more typical in the literature and characterize the search intensity for a formal job, where UI can affect the incentives to search through the value in unemployment $U_{t,d}$. But there could be some substitution between both types of jobs. With a more generous UI, $V_{I,t,1}$ increases, orienting the search effort towards informal jobs. Nevertheless, if benefits are generous but the worker has already exhausted UI period ($d > B$), then the converse is correct: workers orient their effort to formal jobs because $V_{I,t,d>B}$ is smaller but V_{Ft} increases with benefits because only formal jobs allow workers to get UI after job loss.

This depends on the characteristics of the search process, ie. on the functions involved. As an example, if the search process imposed $s_F = s_I = s$ and the cost would be $\Psi(s)$, and job-finding probability was for example, $\pi_F(s) = \theta_F \cdot s$ and $\pi_I(s) = \theta_I \cdot s$, then, no substitution is possible. This last case is consistent with a worker that decides search effort, but does not decide whether this job is formal or informal; that job characteristic is not under worker's control in the search process.

This paper argues that knowing whether the first (directed search) or the second case is the correct case to characterize the search process becomes crucial for the design of UI. It also shows some indirect evidence that some directed search is present. To describe more in detail these effects it is illustrative to consider changes in transfers and prices.

3.1 Effects of UI

To provide a more direct explanation of the effects, lets consider an artificial case in which benefits are constant and permanent and workers can have only two covered UI spells, the current one, that begins at $t = 0$, and a future one, that would occur at an arbitrary T_1. Let b^0 denote the level of UI during the first spell, and b^1 the level of UI in the second spell. Consider now an increase in non-labor income y of a given Δ level of monetary units. This is a lifetime increment of income (and consumption), period by period. This increment can be mechanically replicated by an increase in formal wages, and in benefits in both periods,

so that the following identity holds:

$$\Delta y = \Delta w_F + \Delta b^0 + \Delta b^1.$$

Notice that informal wages do not enter in this equality because UI benefits are also earned while informal, and, then, there is no need to increase informal income if benefits increase. But by adding and subtracting changes in informal wages and rearranging, the equality is

$$\Delta b^0 = \Delta y - (\Delta w_F + \Delta w_I) + \Delta w_I - \Delta b^1.$$

This equation shows that increasing b^0, the UI level of the first spell only, should be equivalent to the sum of several changes that can be identified as the liquidity effect, the moral hazard effect, the directed search moral hazard effect, and the eligibility effect. The liquidity effect relates to larger means of consumption during unemployment (non-formal employment), comparable to an increase in non-labor income, unconditional to the state. This effect is welfare improving. Moral hazard effect suggests that increasing the current benefit implies also a reduction in wages, both for formal and informal jobs, which, in terms of incentives to search would imply lower effort and lower job-finding of both types of jobs. This change implies a welfare loss.

These two effects are well known and discussed in the literature (Chetty, 2008). In our setup, on important difference arise. It is usually emphasized that the liquidity effect would always reduce search effort. In the developing country literature, it is implicitly assumed that liquidity effect would always reduce formal job-finding rate. But in this model, though, higher liquidity could increase s_F whenever $w_F - \tau < w_I + b$, that is, when income while formal is lower than income when informal (and receiving UI). In that case, higher liquidity implies that the difference between utility in both jobs is less important. In a more intuitive line, higher liquidity suggest that workers can invest in searching for better formal jobs without the urgency of increasing current consumption.[3]

The third term, the directed moral hazard, emphasizes that a larger benefit is equivalent to an increase in informal wages. This effect arises because UI transfers are also provided if working informally. In terms of incentives, this effect suggests that search is directed away from formal jobs and towards informal ones. This would be true whenever job-finding is at least partially directed and if it is related to a decision by the worker. In terms of welfare, this effect is positive by itself, as increases income of workers, but of course would have a negative effect on formal job-finding and on the governments' budget, given that informal

[3]Notice that, while with a permanent benefit the condition $w - \tau < w_I + b$ implies $V_I > V_F$ and would eliminate incentives to search for formal jobs, in a limited duration case, it would well be the case of $V_F > V_{I,B}$ as the case we deal with below, in Section 5.

jobs do not collect taxes.

Finally, the last term stands for the eligibility effect. It emphasizes that increasing only the current benefit and not the next spell benefit would reduce future income. Additionally, compared to the case of increasing benefits in all spells, incentives to find a formal job would be reduced. This is related to the fact that b^1 does not directly affect the current level of $U_{t,d}$ or of V_I but does affect V_F, because if the worker loses the formal job would be better off by a higher b^1. This eligibility effect is very relevant in cases of informality because V_I and V_F could be close.

It is important to clarify that the effects, their existence, and derivation do not depend on the artificial case that we used in this subsection. On the contrary, the discussion would be easily extended to the case in which benefits are a constant b^0 and b^1 for a given number of periods B. In such a case, all income should be considered as increments during those periods in which the worker is eligible for UI. Additionally, the description of only two unemployment spells is also not necessary. Consider b^1 as all other future benefits that the worker could have. This more general case is implemented in Section 5.

In sum, all these effects are potentially relevant for the search decision of workers. But the importance of these effects is an empirical question. The next section discusses whether these effects are empirically important and we postpone the quantification of these effects through a quantitative model to Section 5.

4 Evidence

These effects are in line with the empirical facts. First, total effects of b^0 level and duration are frequently analyzed, and studied in many empirical results in the literature. For example, Regression Discontinuity Design (RDD) and Regression Kink Design (RKD) identifications are in fact measuring the effect of current benefit: UI impact is identified through a comparison of two workers, one with higher replacement rate or potential duration than the other under otherwise comparable situations. In particular, future access to UI is similar at both sides of the threshold of an RDD, and, thus, only b^0 effect is measured. The literature discussed in Section 2 provides examples of important effects of UI under that situation.

The analysis of the liquidity effect shows that it is possible that workers with higher liquidity or smoothing consumption means would increase their formal job-finding. This is in line with the empirical finding in the literature related to the consumption.

While liquidity effects have been directly analyzed in the literature (Gonzalez-Rozada and Ruffo, 2011), the directed search moral hazard, and the eligibility effect are rarely identified and computed. What follows reviews the literature to capture some indirect evidence of these

effects.

4.1 Eligibility

Eligibility effect is related to the incentives generated by future benefits on current job-finding rate. An ideal experiment would be to randomly assign current beneficiaries of UI to groups in which some are benefited by the promise of a future more generous transfer (a more generous UI system for all future spells), while others are not. The outcome variables of interest would be the time spent in current UI spell and also the time to formal reemployment.

There is no evidence on this type of measurement in the literature on UI. Nevertheless, some results highlight the potential importance of eligibility effects. Consider a case in which benefits are more generous for the current state only, but not for immediate future spells. Compare that case with a similar difference in transfers but provided to both current spell and all future spells. If the second has lower impact, ie. formal job-finding rate is less affected, then eligibility effect seems important.

Gonzalez-Rozada and Ruffo (2016b) provide evidence on this direction for Argentina. In that country, the UI potential duration depends on the number of contributions in the 36 pre-unemployment months and on age. On the one hand, if workers had 24 instead of 23 months of pre-unemployment contributions, they are eligible for an extension of four months of UI. This comparison identifies the effect of the current covered unemployment spell only: workers with both 23 and 24 pre-unemployment contributions are exposed to the same future system and potential duration. On the other hand, workers are benefited by a six-month UI extension when they turn 45 years of age. This extension is permanent, in the sense that in any future covered layoff they would be benefited by this extension.

In other words, the discontinuity at 45 years of age generates two changes: UI is more generous and formal jobs are more valuable. The discontinuity at 24 contributions generate only one change: UI is more generous. The paper compares the effect of an extension due to the discontinuity at 45 years of age and an extension due to changes in the number of contributions.

Table 1 reports some results for Argentina. It shows that the elasticity of a permanent UI extension (for current and future UI spells) at 45 years of age implies an elasticity of job finding rate of around -0.4 to -0.6. At the same time, a comparable extension of UI potential duration but only for the current UI spell affects formal job-finding rate with a much higher elasticity of between -1.4 to -1.7.

These results are identified through independent regressions or RDD estimates. Line (c) of Table 1 reports two selected coefficients of a regression applied to a sample of workers between 35 to 55 years, where identification exploits the discontinuity at 45 years of age

and at 24 months of contributions. Again, the effect at 45 years of age is about one third of the one measured at 24 months of contributions, for a comparable sample when rescaled considering the effect by month of extension (line (d) of the table).

These results are comparable with our quantitative approach and are consistent with a strong eligibility effect.

4.2 Directed search moral hazard

The next step is to consider whether UI divert search effort away from formal jobs and towards informal jobs. To identify this effect, the formula in Section 4 suggest that the ideal experiment would be to increase informal wages for a group of workers and compare the behavior to a control group. This experiment is not available in the literature, but other results can indirectly speak about the importance of the directed search moral hazard.

Consider first an increase in UI. Higher UI induces lower job-finding rates, due to the traditional effects. But through the directed moral hazard effects informal job-finding could increase at the same time that formal job-finding is reduced. This disparate result is evidence of the directed search moral hazard. This type of result is not available in the literature. Notice that informal job finding is only observed through surveys. It is usually much more difficult to identify through this source the effects of a change in UI: the implementation of RDD and RKD requires typically many of observations in a panel at both sides of a threshold, data usually unavailable for informal jobs in developing countries.

But the effects of UI on directed search can leave another important traces. If directed

Table 1: Effects of an extension of UI potential duration

	At 45 years of age	At 24 contributions
(a) Elasticities	-0.561***	-1.388***
	(0.0528)	(0.2143)
(b) Elasticities	-0.442***	-1.733***
	(0.1379)	(0.4342)
(c) Effect	-.334***	-0.600***
	(0.0872)	(0.0564)
(d) Effect by month of extension	-0.056	-0.150

Notes: The table reports different estimates of the effects of UI potential duration on formal non-employment duration using RDD.
Results are selected from Table 12 in Gonzalez-Rozada and Ruffo (2016b) and (Gonzalez-Rozada and Ruffo, 2011).

search is relevant, it would generate important differential responses among types of job search once UI is exhausted. Any increase in formal job-finding rate could be related to the traditional effects, including liquidity effect. Nevertheless, the reduction in informal job-finding after UI exhaustion, when, at the same time, formal job-finding increases, is related to the disincentive generated by UI. In other words, if there was no directed search, if workers only search for any job and this could then be formal or informal for other reasons, both informal and formal job-finding rate should increase after UI exhaustion.

The evidence presented in Gerard and Gonzaga (2013) is consistent with an important directed search effect in Brazil. Panel (a) of Figure 1 reproduces the total and formal hazard rates of workers after losing their formal jobs. The total hazard rates are the transitions to both formal and informal jobs, and are computed from survey panels available in Brazil. The formal hazard rates are transition from non-formal employment to formal employment and are computed using administrative data for a comparable population. This last has a substantial increase just at the exhaustion period and a month after exhaustion. Importantly, this spike is not present in total reemployment rates, suggesting that informal hazard rate goes substantially down during this period. This evolution suggests that search is directed first to informal jobs and then towards formal jobs, an observation consistent with directed search moral hazard.[4]

Panel (b) of Figure 1 shows the proportion of layoff workers that become employed as informal or formal jobs, after using the previous hazard rates, and abstracting from separations from formal or informal jobs.[5] Importantly formal employment changes reproduces the shape of the hazard rate. Nevertheless, the change of informal jobs goes down substantially at exhaustion. In other words, the evolution of total employment change and formal employment change is only compatible with a reduction in informal jobs in month five to nine after layoff, at UI exhaustion. At the same time, this fall in informal employment suggests job-to-job transitions from informal to formal jobs, that are explained through a moral hazard effect: informal jobs were previously found and then left due to UI distortion. This fall in informal jobs of is as high as 4% monthly in month 6, and implies a cumulative fall in informal employment of almost 10% from month 5 to month 10 after layoff. So strong job-to-job transition suggests that some of these informal jobs are possibly formalizations within the same job.

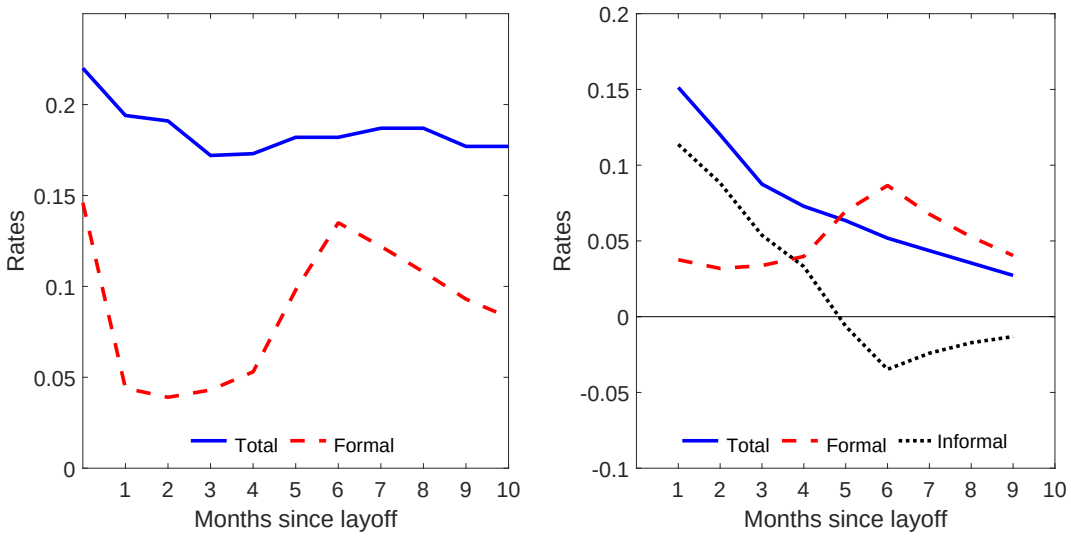
In all, these pieces of evidence suggest a very important directed search effect, and will

[4]Period zero hazard rate of formal jobs could be related to a one month waiting period after layoff and before UI claim is effective.

[5]The plot is constructed observing only total transition rates from non-employment, and formal transition rates from formal non-employment. In other words, only data for one spell of unemployment is provided for this graph. If workers were laid off from the reemployment job, employment change would differ from the one presented in the graph. Still, the plot is illustrative in differences abstracting from that additional effect.

be consistent with the quantitative simulations explored in the follwing section.

Figure 1: Hazard rates and employment change - Workers since layoff



(a) Hazard rates

(b) Employment change

Notes: Panel (a) of the figure plots the hazard rates in Brazil. The figure uses information from surveys (total employment) and from administrative sources (formal employment). Panel (b) of the figure plots the proportion of workers in each employment state after layoff, computed through survival rates for total and formal employment. Informal is computed as a residual. The information comes from Figure 10 in Gerard and Gonzaga (2013). Total and formal employment changes in Panel (b) are consistent with Figure 8.c. of Gerard and Gonzaga (2021).

5 Quantifying effects

Besides the empirical results, quantitative models can be used to assess the importance of these effects on the optimal UI. This section focuses on exploring the consequences of the effects above. The model in Section 3 is specified and calibrated to provide quantitative results, as numerical examples that are useful to compare different scenarios.

Workers are infinitely lived ($T \to \infty$) and are risk averse, with a CRRA utility from consumption,

$$u(c) = \frac{c^{1-\sigma}}{1-\sigma}$$

with parameter $\sigma = 1.5$, and β consistent with a discount rate of a monthly 0.88%.

The specification of the search process includes the search cost,

$$\Psi(s_I, s_F) = \gamma_0 \cdot \left(\frac{1}{1-(s_I+s_F)} - 1 \right),$$

the job-finding probability $\pi_J(s_J) = \theta_J s_J^{1+\alpha}$, where I set $\gamma_0 = 0.5$, $\theta_I = \theta_F = 0.65$, $\theta_E = 0.99$, and $\alpha = -0.025$.

The policy at calibration imply a gross replacement rate of 25% and lasts for half a year. I set $w_I = 0.85 w_F$, $y = 0.12 w_F$ and separation to a monthly rate of $\delta_F = \delta_I = 0.024$. Taxes are endogenously determined, using the budget constraint of the government.

The government is able to set the level of benefits but has to satisfy a budget constraint. There are two alternative budget constraints under consideration. The first is the one that relies on the stationary distribution of workers as employed or unemployed. The second is the actuarially fair budget restriction. In the calibrated economy, the stationary distribution is used (Pay Go budget constraint), and the tax rate is 16%. For other exercises the Actuarially fair budget is used and gives a tax rate of 18% .[6]

[6] See Appendix A for a description of Pay-Go and Actuarially fair budgets.

Table 2: Calibration of parameters and functions

Utility from consumption			
	Function	$u(c) = \frac{c^{1-\sigma}}{1-\sigma}$	
	Parameters		
		σ	1.5
Search cost			
	Function	$\Psi(s_I, s_F) = \gamma_0 \cdot \left(\frac{1}{1-(s_I+s_F)} - 1\right)$	
	Parameters		
		γ_0	0.5
Job-finding			
	$\pi_J(s_J) = \theta_J s_J^{1+\alpha}$		
	Parameters		
		α	-0.025
		θ_F	0.65
		θ_I	0.65
		θ_E	0.99
Separation rates			
		δ_F	0.1340
		δ_I	0.1340
Discount factor		β	0.9487
Income			
		w_F	0.5000
		w_I	0.4250
		y	0.0600
		b	0.1250

Notes: The table reports the parameters used for quantitative exercises. The model period represents six months.

5.1 Results

Table 3 shows some characteristics of the calibrated economy, under a Pay-Go government budget. It first shows that the tax rate should be relatively high, at 16%. This is mostly to finance other transfers (y) and not UI, because the UI related tax rate is only 1.9%. This is a main role of fiscal externality: at this stage, any distortion on formal search would be much costlier than if the tax were only to finance UI.

The lower panel shows the job-finding rates (monthly equivalent rates). The table reports different cases, considering the eligibility period and after UI exhaustion. It shows that under eligibility, formal job rate is about 7% while informal job rate is around 4%. After UI exhaustion, the incentives to formalize are much higher: formal job-finding rate becomes about 10% by month, and informal-to-formal transition rates are at similar levels. At the same time, informal job-finding rate falls to 1.6%. This situation is in line with the discussion above: after exhaustion, the incentives to direct job search towards formal jobs increases, while the incentives to search for an informal job is reduced. Importantly, these effects are only possible when directed search is allowed.

Finally, column (b) of the table reports the stationary distribution of workers. It shows

Table 3: Calibrated model

Replacement rate	0.250	
Tax rate	0.161	
Tax rate to fainance UI	0.019	
	(a)	(b)
	Job-finding	Employment
Formal in eligibility	0.0666	0.114
Informal in eligibility	0.0398	0.021
Formal after exhaustion	0.1030	0.735
Informal after exhaustion	0.0165	0.037
Job-to-job	0.1045	
Unemployed in eligibility		0.044
Unemployed (no UI)		0.050
Total unemployment		0.094
Total formal		0.848
Total informal		0.058

Notes: The table reports some features of the calibrated model economy with Pay Go budget constraint. Column (a) reports monthly job-finding rate by type of transition; column (b) reports the proportion of workers in each case.

that unemployment is as high as 9%, informality is 6% of the population and formal workers represent 85% in this calibration. Notably, even with this low informal rate, incentives are very much changed, and the design of UI shows very different issues compared to the ones without informality, as I discuss below.

5.2 Effects

Table 4 shows the effects on initial formal job-finding rate of a series of unbalanced changes in parameters of the model, to quantitatively evaluate the effects discussed in Section 4. As described in that Section, the effects should be computed during the eligibility period. For that reason, changes in parameters, such as changes in y, w_F, etc., only apply for the period of covered unemployment spell (one model period in this calibration).

The table reports derivatives, computed by marginal changes in parameters. To be clear, results in the table do not include any change in taxes to balance government budget. For that reason, they are not useful to directly assess the welfare effects of changes in benefits. Column (1) of the Table shows these results for the calibrated model, under Pay-Go budget constraint and taxes, while remaining columns deal with different levels of replacement ratios and different calibrations.

The first effect is an increase in benefits. We consider this the Total Effect. This implies increasing the parameter b for all UI spells. In the calibrated model, increasing benefits by one unit reduces initial formal job-finding rate by 0.99. This is equivalent to an elasticity of -0.35.

The second line evaluates the effect of increasing only benefits during the first UI spell, leaving the remaining benefits unchanged. This shock implies a higher effect on the initial formal job-finding rate, that almost doubles the value of the derivative.

The third line evaluates the liquidity effect. This is a marginal increase in liquidity (Δy in Section 4). Notice that this effect is very strong and positive. It shows that under the possibility of substituting formal or informal job search, higher liquidity reduces incentives to find a bad job, or a transitory informal income, and increases the formal job-finding probability in the eligibility period. This is important, given that the literature has considered this effect to be always negatively related to formal job-finding rate. It implies that, through this effect, benefits generate welfare gains, but also increase incentives to formalize jobs.

The fourth line is the moral hazard effect generated by a decrease in formal and in informal wages of the same monetary units. Interestingly, this effect do not generate changes in relative net wages in job types. Given that marginal utility do differ, the incentives effects are in fact stronger for the formal job. In all, this implies lower incentives to search for a job, and formal job-finding in the eligibility period falls.

Then, the next effect is the directed search moral hazard, which implies an increase in informal wages during the eligibility period. Such a shock increases the value of informal jobs and induces workers to search more for informal jobs. If the possibility of substitution between job types is high, effect on formal job-finding rate would be negative. The corresponding line in the Table shows that directed search moral hazard is very important in the model economy, much stronger than the moral hazard effect. It suggests that UI should be designed carefully because otherwise it could orient workers to search for informal jobs. Its effect is more damaging if informality was a very persistent state. Importantly, through this effect there are also negative incentives for job-finding rate even after the eligibility period, both directly from unemployment or through informal-formal job-to-job transitions. In all, this effect could be of substantial importance and limits the generosity of UI that the government could provide because of the generated disincentives, and the moral hazard that arises when the government is unable to observe informal jobs.

Table 4: Effects of changes in parameters on the initial formal job-finding probability

	(1)	(2)	(3)	(4)	(5)
	Baseline	Optimal level			
			Actuarially fair budget		
				No dir. search	Low repl.
Replacement rate	0.25	0.34	0.25	0.43	0.15
Effects					
Total	-0.99	-1.35	-1.10	-0.03	-0.07
b0 effect	-1.83	-1.98	-2.06	-0.04	-0.07
Liquidity	2.01	2.15	2.23	-0.02	-0.06
Moral hazard	-1.02	-1.45	-1.22	-0.01	-0.01
Directed search	-1.98	-2.05	-2.11	0.01	0.00
Eligibility	-0.84	-0.63	-0.96	0.00	0.00
Sum	-1.82	-1.99	-2.06	-0.03	-0.07
Residual	0.00	0.00	0.00	0.00	0.00

Notes: The table reports the effects on the eligibility period formal job-finding probability, as derivatives considering half year rates. Each column is a different calibrated economy. Column (4) implies $s_F = s_I$, while column (5) considers a lower replacement rate under the same constraint in search.

The last effect is the eligibility effect, related to the decrease in all future unemployment spells, but leaving the initial UI level unchanged. This value is computed as a difference between the first and the second line, and it shows that decreasing future UI implies a strong negative effect on initial formal job-finding rate. This effect is almost as important as the total effect in the first line. The simple decomposition of current and future UI implies that

increasing only the current UI would lead to a reduction in job finding of -1.8, but increasing in the same amount all future UI would increase job finding in 0.84, compensating much (almost half) of the change in behavior.

Importantly, these effects are only part of the total effects that the model economy is experiencing. As an example, the increase in initial UI (the effect in the second line of the Table), would imply an increase in job-to-job transition rates towards formal employment ($\pi_E(s_F)$). This is because, through the eligibility effect, the value of being formal is increasing due to higher future UI benefits. Notice that an increase of UI transfers just the first period would result in no change in this rate.

This shows that the eligibility effect should have a substantial role in the design of the optimal UI level, and could help balance the demand for a formal job, both through moderating the disincentives to search in the current eligibility period and through increasing the incentives to formalize the job after the eligibility period.

Of course, it could be argued, the increase in future benefits could generate higher distortion through the budget constraint. If all future benefits have a strong impact on governments budget and the high increases in taxes are very distortive, this would mean that the comparison between current and future benefits is inadequate for welfare effects. The remaining of the section goes through the welfare effects of these changes, and explores this particular issue.

Before exploring welfare gains, it is relevant to explore the quantitative impact of these effects under different conditions, levels of UI transfer, and calibrations, reported in different columns of Table 4.

Column (2) of Table 4 shows the same economy but at the welfare maximizing UI level (maintaining duration constant). This is a replacement rate of 34%. In this case, all effects are stronger, with the exception of the eligibility effect, which is somewhat reduced.

Column (3) shows the economy considering the actuarially fair budget. In this economy, taxes should be higher to balance the budget and the optimal level of benefits is only 25%. Effects are, though, very similar to the ones discussed.

Column (4) reports the results for the case in which search cannot be directed, ie. when $s_F = s_I = s$, and $\pi_F(s) = \pi_I(s)$. The only exception to this case could be when $V_F < U_d$, in which case formal jobs are not accepted and $\pi_F(s)$ would be imposed to be zero. In other words, this explores the no directed search case when actuarially fair budget is used. In this case, the welfare maximizing policy is a replacement rate of 43%. This is much higher, in part because some effects differ. For example, the directed search moral hazard is positive in this case: higher informal wage induces workers to search in general, increasing both formal and informal job-finding. Liquidity effect also changes its sign, through the traditional effects. In

any case, all effects are very small in this economy.

Finally, Column (5) of the Table shows the same model economy but with a much lower transfer level, equivalent to a replacement rate of 15%. In this case, all results are qualitatively similar but stronger compared to the ones in the previous column.

5.3 Welfare

Consider now the welfare effects of benefits and other changes in parameters. Welfare is measured through the lifetime utility of a worker without a job and at the beginning of the unemployment eligibility period, $J_{0,1}$. This is the usual way to evaluate the UI policy in the literature.

It is convenient to compare welfare gains in terms of consumption equivalent changes. Let $J_{0,1}^B$ and $J_{0,1}^R$ be the lifetime utility at the benchmark economy and at a shocked economy, respectively. The measure of welfare change, would then be

$$\mu = \left(\frac{J_{0,1}^R}{J_{0,1}^B} \right)^{\frac{1}{(1-\sigma)}} - 1, \tag{1}$$

where μ is a consumption equivalent proportional change in consumption that leads to the same difference in welfare as between the two value functions.

Table 5 shows the result of the unbalanced change in parameters on welfare. The columns and lines identify the same economies as in Table 4, but this table reports welfare gains, using consumption equivalent changes.

The first line in column (1), for example, shows that the marginal increase in one monetary unit in benefits would be valued in about 41 cents. When the increase in benefits is only for the first covered UI spell, the equivalent is 15 cents.

Liquidity effect implies an increase of 57 cents. Notice that these effects are only changes during eligibility periods. It is reasonable, then, to find values smaller than one. Additionally, it is also important to consider the fact that per period utility is determined not only by consumption but also by search effort. Thus, an increase in income in all periods would not necessarily be valued as a consumption equivalent of one.

The eligibility effect is also important. A marginal increase in transfers in one monetary unit for future UI spells would be equivalent to an increase of 26 cents in consumption (recall that the eligibility effect in Section 4 is considered as a reduction in benefits; this is why the sign in the table is negative). This important welfare gain is comparable and even higher than the effect of an increase in only current UI benefits.

To account for the importance of eligibility effect I now turn to evaluate the welfare

Table 5: Welfare effects of of changes in parameters (CE)

	(1)	(2)	(3)	(4)	(5)
	Baseline	Optimal level	Actuarially fair budget		
				No dir. search	At low repl.
Replacement rate	0.25	0.34	0.25	0.43	0.15
Effects over welfare					
Total	0.41	0.28	0.39	0.22	0.63
b0 effect	0.15	0.10	0.15	0.09	0.26
Liquidity	0.57	0.44	0.54	0.29	0.69
Moral hazard	-0.10	-0.10	-0.09	-0.06	-0.06
Directed search	-0.05	-0.06	-0.04	0.00	0.00
Eligibility	-0.26	-0.18	-0.24	-0.13	-0.37
Sum	0.15	0.10	0.16	0.10	0.26
Residual	0.00	0.00	-0.02	-0.01	0.00

Notes: The table reports welfare gains of changes in parameters, as derivatives considering consumption equivalent measures. See notes to Table 4.

maximizing policy considering both the initial and the remaining UI spells. Differing from results in the previous tables, now I consider balanced budget effects. Now, any increase in benefits would imply an increase in taxes. Both increments would derive in reducing the incentives to search for a formal job. The lower formality in the economy would amplify the impact on government budget of the increase in benefits.

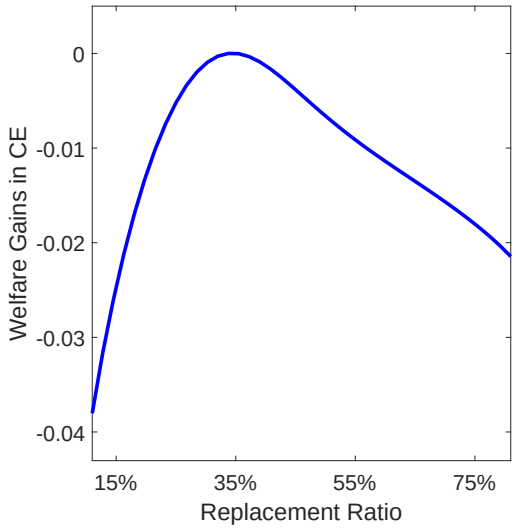
Figure 2 shows the welfare effects of different replacement rates. To provide an evaluation of welfare gains, the formula in 1 is used, considering the welfare maximizing replacement rate as the benchmark economy.

The solid blue line of the figure represents the calibrated economy, under Pay-Go government budget. The welfare maximizing replacement rate is close to 34%. Reducing UI benefits affects substantially the welfare of workers. At the same time, increasing benefits induces taxes to be distortive.

Panel (a) of Figure 3 reports the same exercise for an economy with an actuarially fair budget. The solid blue line reports that the welfare maximizing replacement rate is 25% and that higher replacement rates rapidly become very distortive, mostly through the increase in taxes: replacement rates higher than 35% generate an increase in taxes that become inconsistent with a formal economy.

The red dashed line of the same figure shows the effects of a balanced budget increases

Figure 2: Welfare gains by replacement rate (Pay Go)



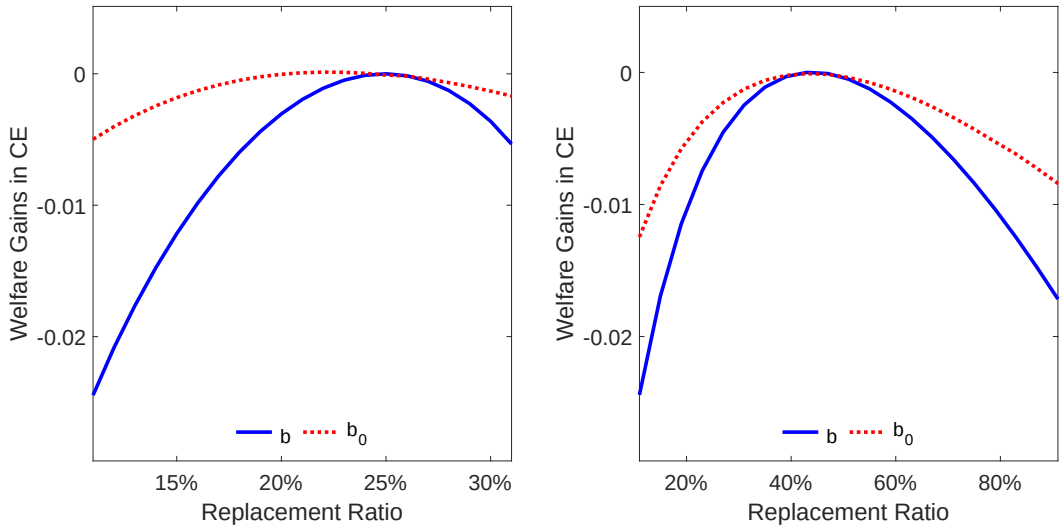
Notes: The figure plots the welfare effects of considering different balanced budget changes in taxes for the calibrated economy. Welfare is measured as a consumption equivalent change from the welfare maximizing level of UI.

of transfers during the first eligibility period only. In other words, this would be similar to the exercise presented in the second line of Table 5, but in this case considering a balanced budget (increasing lifetime taxes so that to finance this increment of the first period UI only). Notice that this shock does not include the eligibility effect, given that future benefits do not provide additional incentives to formalize. For a more reasonable comparison, while changing transfers of the first eligibility period only, remaining transfers are set fixed to their welfare maximizing level. Thus, the welfare of setting the same benefits during the first period to the level of the constant replacement rate would be the same as in the blue line discussed before. The question is whether welfare increases or decreases after a marginal balanced budget increase in the first period benefit. We find that welfare decreases, considering the slope of the red dashed line. Additionally, the figure shows that, if it was possible to only change the first period level, it would be lower than the 25% welfare maximizing replacement rate, close to 22%.

Panel (b) of Figure 3 reports the same exercises after imposing no directed search, that is, workers cannot direct the search towards informal jobs. Such a case generates lower distortions in search and allow for increasing the replacement rate more. The optimal replacement rate is 43%. Additionally, the eligibility effect is less relevant: the red dashed line is flat at the level in which the first spell replacement rate equals the replacement rates of remaining UI spells.

This result suggests that the eligibility effect by itself could be important. It also suggests that directed search and eligibility effects reinforce the importance of each other.

Figure 3: Welfare gains considering all replacement rates or only first eligibility period



(a) Actuarially fair (b) Actuarially fair and no directed search

Notes: The figures plot the welfare effects of considering different balanced budget changes in taxes, considering actuarially fair budgets. In panel (a) workers can partially direct their search towards formal or informal jobs. In panel (b) search effort is imposed to be equal in both markets. Blue solid lines represent changing the replacement rate for all UI periods. Red dashed lines represent the case in which only the replacement rate is changed for the first covered UI period, setting the remaining benefits at the constant optimal level. Welfare is measured as a consumption equivalent change from the welfare maximizing level of UI.

6 Discussion

The quantitative exercise of Section 5 is illustrative of the effects that arise as important when considering informality in the problem of designing UI. It shows that liquidity effect very relevant and that it can be positive, in contrast to what is assumed in the literature. It also shows the quantitative relevance of two effects that are simply omitted within the literature: the eligibility effect and the directed search moral hazard. It shows that both effects are substantial importance and considering them can be crucial for the optimal design of UI.

This section discusses some caveats and issues related to this approach.

Some issues on the approach implemented here are worth noting. First, the effect of taxes are usually implemented in the literature as a way, a shortcut, to introduce the distortions that any tax would have on the labor market and the economy as a whole. In this case, though, the effect of taxes should be considered in a more general equilibrium environment, where the formal and informal demand of workers should be also represented, letting the incidence of taxes to be an endogenous result.

Additionally, macroeconomic effects of reforms of UI are also important. Changes in

UI can reduce beneficiaries' formal job-finding rate, but can also improve non-beneficiaries' formalization, if the demand for formal jobs is somewhat rationed (Landais et al., 2018). Thus, this type of spillover effects should be also considered. The empirical literature on UI in developing countries do not explore this important issue, but a model could do so.

Finally, some additional general equilibrium effects through factor prices (wages and returns to capital) are potentially important in the design of UI in developed countries (Piguillem et al., 2023), and possibly in developing countries also.

7 Concluding remarks

This paper deals with the particular issues that informality introduces when analyzing the design of unemployment insurance. It emphasizes the importance of effects not considered in the literature, the eligibility effect and the directed search moral hazard effect. It also shows how other well known effects, such as the liquidity effect, could be qualitatively different if the search process of the worker is taken into account.

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Appendix

A Government's budget

A.1 Pay - Go

Consider now the government that aims to maximize utility subject to a constraint. To simplify that constraint, the following simple case of Pay-Go budget is considered:

$$\tau e_F - b u_0 - b e_{I0} - y = 0$$

where e_F is the expected proportion of time the worker spends in formal employment, u_0 is the proportion of time the worker spends in a covered unemployment spell, e_{I0} is the proportion of workers informally employed during the eligibility period, and y is a per period per capita expenditure that taxes should finance, a source of fiscal externality. These proportions are computed by simulation after solving the decisions of workers, and transition rates. This type of constraint is frequently used in the literature.

A.2 Actuarially fair

An actuarially fair budget requires that the present value of expected costs all UI spells and other transfers should be balanced by a tax collected to formal employment. This requires that $C_{JU} = 0$, where

$$C_{JU} = \pi_F(s_F) C_F + \pi_I(s_I) C_{IU} + [1 - \pi_F(s_F) - \pi_I(s_I)] C_U$$

is the expected present discounted value of the cost for the government at the beginning of the unemployment spell. C_U is the cost for the government of a worker that collects UI:

$$C_U = b + \beta [\pi_F(s_F) C_F + \pi_I(s_I) C_{IS} + [1 - \pi_F(s_F) - \pi_I(s_I)] C_S]$$

C_{IU} considers the case of an informal worker that collects UI (during eligibility period):

$$\begin{aligned} C_{IU} = b &+ \beta\delta_I [\pi_F(s_F) C_{F0} + \pi_I(s_I) C_{IS} + [1 - \pi_F(s_F) - \pi_I(s_I)] C_S] \\ &+ \beta(1 - \delta_I) [\pi_E(s_E) C_{F0} + [1 - \pi_E(s_E)] C_{IS}] \end{aligned}$$

C_F stands for the case of a formal worker that pays a tax τ:

$$C_F = -\tau + \beta [\delta_F C_{JU} + (1 - \delta_F) C_F]$$

At the end of the eligibility period, the expected cost of searching and of being in an informal job are:

$$C_S = 0 + \beta [\pi_F(s_F) C_F + \pi_I(s_I) C_{IS} + [1 - \pi_F(s_F) - \pi_I(s_I)] C_S]$$

and

$$\begin{aligned} C_{IS} = 0 \quad &+ \quad \beta\delta_I \left[\pi_F\left(s_F\right) C_F + \pi_I\left(s_I\right) C_{IS} + \left[1 - \pi_F\left(s_F\right) - \pi_I\left(s_I\right)\right] C_S\right] \\ &+ \quad \beta\left(1 - \delta_I\right)\left[\pi_E\left(s_E\right) C_F + \left[1 - \pi_E\left(s_E\right)\right] C_{IS}\right] \end{aligned}$$

All value functions are assuming that there is only one period of eligibility, as implemented in our calibration.

These functions can be computed through the optimal decision of the worker as described in Section 5. Once these are set, the tax is updated to balance the budget, and the iteration is repeated until convergence.